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Design optimization using adjoint of Long-time LES for the trailing edge of a transonic turbine vane CHAITANYA TALNIKAR, QIQI WANG, Massachusetts Inst of Tech-MIT — Adjoint-based design optimization methods have been applied to low-fidelity simulation methods like Reynolds Averaged Navier-Stokes (RANS) and are useful for designing fluid machinery components. But to reliably capture the complex flow phenomena involved in turbomachinery, high fidelity simulations like large eddy simulation (LES) are required. Unfortunately due to the chaotic dynamics of turbulence, the unsteady adjoint method for LES diverges and produces incorrect gradients. Using a viscosity stabilized unsteady adjoint method developed for LES, the gradient can be obtained with reasonable accuracy. In this paper, design of the trailing edge of a gas turbine inlet guide vane is performed with the objective to reduce stagnation pressure loss and heat transfer over the surface of the vane. Slight changes in the shape of trailing edge can significantly impact these quantities by altering the boundary layer development process and separation points. The trailing edge is parameterized using a linear combination of 5 convex designs. Bayesian optimization is used as a global optimizer with the objective function evaluated from the LES and gradients obtained using the viscosity adjoint method. Results from the optimization, performed on the supercomputer Mira, are presented.

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